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The Combustion Fuel Oil Burner

Manufactured By

MILWAUKEE AIR POWER PUMP CO.

8 KEEFE AVE. -:- -:- MILWAUKEE, WISCONSIN

Semi-technical Bulletin
Number 40-B

MILWAUKEE AIR POWER PUMP CO.
MILWAUKEE, WISCONSIN

B.3.

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The object of this bulletin mainly is twofold. First, to tell about oil burning and, second, to tell about the Combustion Burner.

COMBUSTION

Combustion is the chemical combustion of various GASES with oxygen. The chemical combustion gives off heat in direct proportion to the amount of oxygen combined. This statement applies to all fuel including coal, wood or liquid fuel. The fuel, whatever its nature, must be converted into a gas before it will combine with oxygen and burn. Moreover, the combination must be heated to the ignition temperature. Solid fuel is converted into gas by the heat of the fire. Liquid fuel is prepared for combustion by spreading it out into a thin layer or dividing it out into fine particles or gas-like mist. This gas-like mist, due to the fine division of the fuel is easily converted into gas by the heat of the fire or in the case of the lighter fuels to a certain extent by the heat of the surrounding air or by the heat of the ignition flame or spark.

The greatest amount of liquid fuel (probably amounting to 95% of all liquid fuel burned) is prepared for combustion by atomization by means of steam or air under pressure in an ordinary nozzle somewhat similar to a throat spray or perfume atomizer.

Aside from atomization by means of a nozzle, two other ways are in common use. The first being atomization by centrifugal force; the other being vaporization by means of a hot pot. Only the lighter grade of fuel oils are commonly handled by the two last named means, the nozzle method being the one universally applicable to any kind of fuel in any kind of a combustion chamber or fire box.

The nozzle method of atomization is the one that is used commonly thruout the world on steamships, railroad locomotives, in large industrial installations, and is now in the last 8 years thru the Combustion system, made available for residences and other relatively small sized applications.

ADVANTAGE OF THE COMBUSTION SYSTEM

The combustion system is one which is very flexible in its application to all types of heating plants. One nozzle or several nozzles may be operated from a single burner unit; thus a single unit is often used to fire two or more boilers at the same time and in mild weather part of the boilers may be shut down permitting the operation of the remaining boilers at their maximum efficiency.

Nozzles, of which there are three sizes in each of three types, are adjustable or adjusted for both air and oil so that the proper number and size of nozzles may be used for any given application. This permits firing each type of boiler with a flame which, in a measure, is of the best shape and size for that particular boiler, this obviously being both preferable and more economical than to attempt to fire all boilers having a wide range of sizes and of combustion chambers and heating surfaces with a single stereotyped form of burner which, at best, can only be a compromise designed for some one boiler.

The Combustion Burner, with its nozzle type of atomization, can efficiently burn heavier grades and, therefore, cheaper grades of fuel oil than is practical with other types of atomization.

A wide range of sizes of units have been designed, built and applied to almost all known standard sizes and types of boilers and these have been in service all over the United States for various lengths of time up to seven or eight years, dating back to October, 1919, when the first home installation of this burner was made. (By the way, this burner is still in service and giving satisfaction.)

In the interim changes in arrangement of parts of this burner have been made but there has been no change in principle of firing, consequently we can claim with fairness that the Combustion Burner is far removed from the experimental stage; in fact pointing to the thousands that are in service we can say that the Combustion Burner is a well developed, satisfactory and efficient type of burner. It not only has given satisfactory service in the past, but in the future will remain among the best intrenched and most satisfactory of domestic Fuel Oil Burners on the market.

THE COMBUSTION OIL BURNING SYSTEM

The Combustion system utilizes the nozzle method of atomizing or spraying the fuel. This system can efficiently burn the heavier and cheaper grades of fuel due to its air jet method of atomization. Eight years of experience with this method of burning fuel oil and several years of study and testing previous to this has revealed no other method equally as good.

The Type "D" Combustion Burner is the only one using 24° gravity fuel oil with full automatic control for home heating which has been fully approved and listed as standard by the Underwriters' Laboratories.

The Combustion system comprizes five simple elements as follows:

First, the air jet atomizer or nozzle; second, the ignition; third, the direct connected motor driven air compressor and oil pump; fourth, the automatic thermostatic controls and the safety controls; fifth, the oil storage tank.

Nine standard sizes of the Combustion Burner have been developed and are available. They range in size from the No. 0 unit capable of taking care of 500 sq. ft. of connected steam radiation, to the No. 16 unit capable of taking care of 67,000 sq. ft. of steam radiation.

Combustion units according to the different sizes have a rated capacity to take care of the number of square feet of steam radiation stated below.

Size		Size	
0	500 square feet	8	12000 square feet
1	1000 square feet	12	26000 square feet
3	2400 square feet	14	40000 square feet
4	4000 square feet	16	67000 square feet
6	8000 square feet		

Since each square foot of steam radiation is assumed to dispose of 240 B. T. U.'s per hour the foregoing table can also be stated as below.

Size		Size	
0	120,000 B.T.U.'s per hour	8	2,880,000 B.T.U.'s per hour
1	240,000 B.T.U.'s per hour	12	6,240,000 B.T.U.'s per hour
3	576,000 B.T.U.'s per hour	14	9,600,000 B.T.U.'s per hour
4	960,000 B.T.U.'s per hour	16	16,080,000 B.T.U.'s per hour
6	1,920,000 B.T.U.'s per hour		

Combustion units will release the below stated amount of B.T.U.'s per hour. This allows for 1/3 loss between the furnace and the radiators. The table below, therefore, is the same as the table above with 33-1/3% added.

Size		Size	
0	160,000 B.T.U.'s per hour	8	3,840,000 B.T.U.'s per hour
1	320,000 B.T.U.'s per hour	12	8,320,000 B.T.U.'s per hour
3	763,000 B.T.U.'s per hour	14	12,800,000 B.T.U.'s per hour
4	1,280,000 B.T.U.'s per hour	16	21,440,000 B.T.U.'s per hour
6	2,560,000 B.T.U.'s per hour		

Since a gallon of average fuel oil contains 140,000 B.T.U.'s the table just above means that different units burn the quantity of oil in gallons stated below.

Size		Size	
0	1.15 Gals. per hour	8	27.4 Gals. per hour
1	2.29 Gals. per hour	12	59.4 Gals. per hour
3	5.48 Gals. per hour	14	91.4 Gals. per hour
4	9.14 Gals. per hour	16	153. Gals. per hour
6	18.3 Gals. per hour		

THE ATOMIZING NOZZLE

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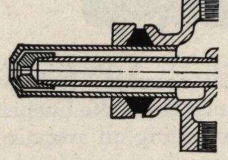


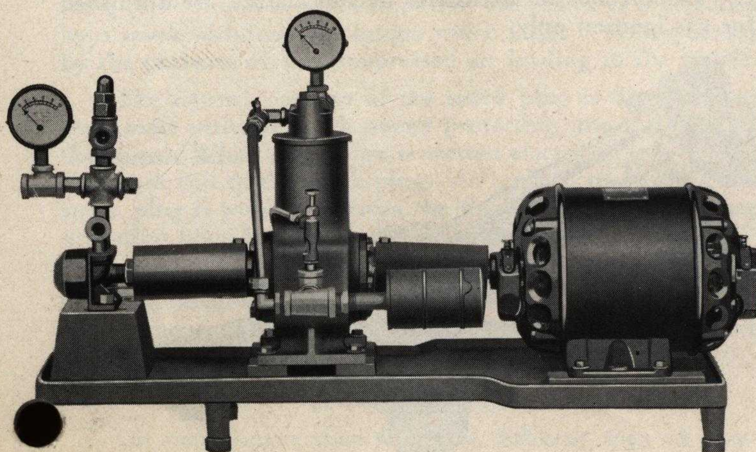
This nozzle operates similar to the ordinary throat spray or perfume atomizer. It has a central tube thru which the oil flows and this is surrounded by a larger tube thru which the air flows. The air jet impinges on the central oil stream from all sides at a sharp angle and atomizes the oil so finely as to resemble a mist.

The compressed air also spreads the mist and this enables it to mix most intimately with the combustion air. This mixture is so perfect that the flame may be burned steadily in the open air.

Ahead of the nozzle in the oil line is an anti-syphon valve interconnected with the compressed air supply in such a manner that the oil valve cannot open until sufficient air pressure is built up in the atomizing system to thoroughly atomize the oil. When the burner is shut down and the air pressure, therefore, dies down, the anti-syphon valve closes completely shutting off the oil.

Nozzles are fired at the factory and are adjusted at an approximately serviceable setting. At the actual installation further final adjustment of the air and oil may or may not be required.

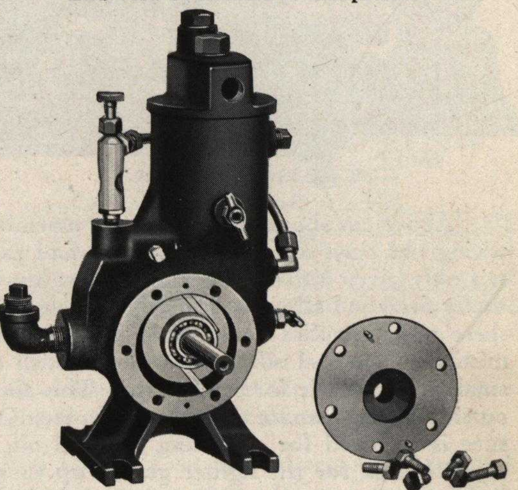
The Power Plant—Sizes 0, 1 and 3



For the gas ignition units the air tube of the atomizing nozzle is adjustable so as to vary the characteristics of the flame to best suit a given furnace or combustion space.

The nozzles for the electric ignition unit outwardly resemble the gas ignition type of nozzle. In practice, however, a departure is made from the gas ignition type of nozzle in that the air tube in the electric ignition type of nozzle is not adjustable. It is screwed down tight against the oil tip which latter has machined in it proper air passage-ways. If any adjustment of the air pressure is necessary this is provided for by an adjustable air relief valve on the unit.

End View of Interior of Compressor



The Power plant, sizes 0, 1 and 3 consists of a direct connected motor driven air compressor and oil pump. It is a completely assembled unit on a single base.

The motor is of standard make of a type suited for the voltage and current available at the place of installation.

The air compressor is a simple machine of the positive displacement type. It supplies air at practically constant pressure to the nozzle for atomizing the fuel.

The compressor is provided with ball bearings and non-seizing impeller blades, the latter are self-adjusting for wear.

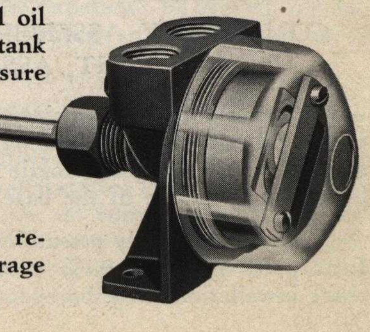
It is also provided with a proven efficient automatic circuit lubricating system by means of which a small amount of lubricating oil is used over and over again to lubricate the rubbing parts of the compressor.

The impeller blades of the compressor are of special alloy fitting in slots in the rotor. As the rotor revolves the blades are thrown out and held against the walls of the compressor by centrifugal force and by their revolution deliver the air for atomization.

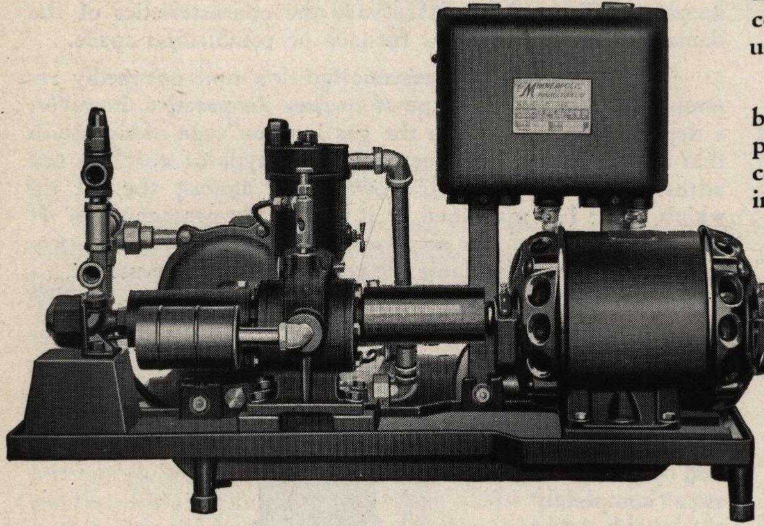
Actual experience shows that the efficiency of the compressor increases with use.

The oil pump for supplying the fuel oil to the burner is of special design consisting essentially of two square pistons operating from an eccentric. By this method we circulate the oil without the use of gears and practically without pulsation. The oil pump draws the fuel oil from the outside storage tank maintaining a steady oil pressure at the nozzle by means of an automatic bypass valve which in addition to maintaining a steady pressure also serves to permit the excess oil to be returned to the outside storage tank.

Phantom View



Sizes 0, 1 and 3



Above cut shows the completely assembled unit. All the wiring has been done at the factory and each unit has been not only given a five hour running test but has also been actually fired and all parts properly adjusted. The air pump on these units supplies compressed air only for atomizing and mistifying the fuel oil. It does not furnish (except in a very small part) the air for combustion. This air is taken in from outside of the furnace thru the draft, etc. Only a small pressure is required for atomizing the fuel oil, this varies from 2 to 2½ lbs. for the lighter grades up to about 4 lbs. or a little over for the heavier grades of fuel oil. The air compressor as already referred to is provided with a circulating lubricating system. The lubricating oil is drawn into the pump with the intake air, being supplied thru an adjustable sight feed lubricator which is to be regulated to supply 15 to 20 drops of oil per minute. The lubricating oil after passing thru the pump is separated and is returned again to the oil reservoir from which it is used over and over again. This part of the unit should be looked after periodically and fresh oil supplied from time to time as it is used up in the compressor.

Oil of proper quality as designated on the operating instructions furnished with each unit should be used.

If oil of improper quality is used for compressor lubrication or if insufficient oil is used the compressor blades may become gummed up and stick. This can usually be corrected by slowly feeding a few tablespoonfuls of kerosene into the compressor thru the suction intake with incoming air while the unit is running. If it is ever necessary to apply the above remedy see that the compressor is supplied with proper lubrication after the kerosene bath.

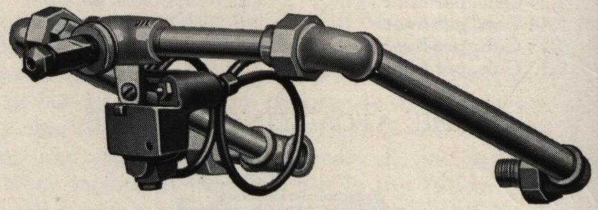
COMPLETELY ASSEMBLED UNITS OR TWO UNIT ASSEMBLIES

In the standard small size assembly the motor, compressor and oil pump are mounted on a common base and this base also carries the complete nozzle assembly which is bolted to a bracket on the side of the base.

These completely assembled units are proper and satisfactory for probably 95% of all installations but here and there installations may be encountered where it is not practical because of want of space or other causes to install the completely assembled unit and for such installations the two unit assembly can be had.

The two unit assembly consists of two parts—the first being the complete power plant consisting of motor, compressor and oil pump mounted on one base and the other the complete nozzle assembly mounted upon a stand pipe bracket independent of the power plant.

Single Nozzle Assembly



With the two unit assembly it is possible to place the power plant at a distance from the burner nozzle assembly by merely running the extending oil and air lines connecting the power plant with the nozzle assembly.

This construction is frequently used where boilers are fired from the rear and where the space back of the boiler would either not permit of installing the power plant there or if it was there installed it will not readily be accessible for attention.

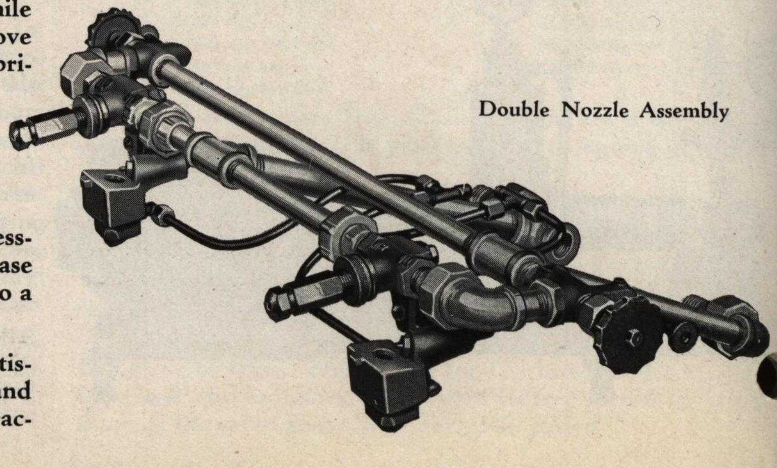
The parts used in the two unit assembly are identical with those used on the complete assembly with the exception of the extra stand pipe mounting bracket which is needed with the two unit nozzle assembly.

DOUBLE NOZZLE ASSEMBLY

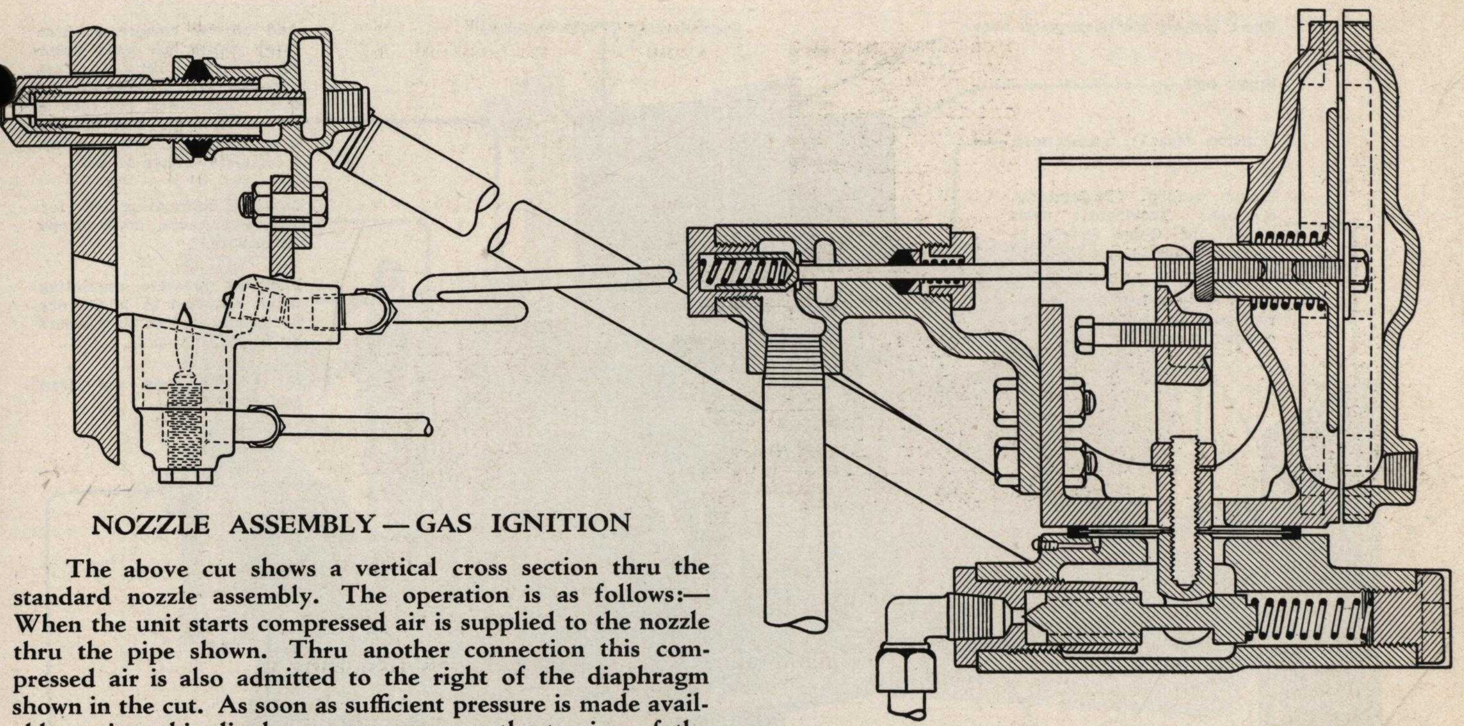
In the case of the No. 3 unit the double nozzle assembly is also available. This is similar to the standard single nozzle unit except that it carries two burner nozzles separated a certain distance as may be called for where it is necessary to fire a wide combustion chamber. These nozzles may be separated any reasonable distance up to 24 inch centers.

In the case of double nozzle assemblies each nozzle is provided with its own oil metering valve and its own gas pilot for ignition.

Double nozzle assemblies of this nature are furnished for gas ignition only.



Double Nozzle Assembly



NOZZLE ASSEMBLY — GAS IGNITION

The above cut shows a vertical cross section thru the standard nozzle assembly. The operation is as follows:— When the unit starts compressed air is supplied to the nozzle thru the pipe shown. Thru another connection this compressed air is also admitted to the right of the diaphragm shown in the cut. As soon as sufficient pressure is made available against this diaphragm to overcome the tension of the coiled spring shown as resisting the movement of this diaphragm, it moves to the left opening the gas valve shown and also thru the medium of the upright lever opening the oil valve as shown.

The oil valve, therefore, is not opened until sufficient pressure, as determined by the coiled spring, is available to atomize the oil when it reaches the nozzle. The compressed air has started flowing thru the nozzle and attained a certain pressure before the oil valve opens.

This interlocking of the air and oil also serves as an efficient anti-syphon valve because as soon as the unit shuts down and the air pressure is decreased in the air line the oil valve closes off while there is still a considerable flow of air at the nozzle, the result being that the oil is completely atomized as it is not admitted until sufficient pressure is obtained at the nozzle to atomize it and is shut off before the atomizing air pressure at the nozzle dies down.

For the ELECTRIC IGNITION nozzle assembly the same construction is used except that the gas valve is replaced by a spark withdraw diaphragm which latter is also operated by the pressure of the compressed air leading to the nozzle.

The normal position of the spark plug is directly over the nozzle with the spark points projecting into the path of the spray. When the burner is started electricity is sent thru the spark coil to the spark plug. As ignition takes place the spark plug is withdrawn from the flame, by the air pressure operating upon the withdraw diaphragm.

The spark plug is withdrawn so as to keep it free from soot and possibly injuring the spark points thru overheating and as the spark plug is withdrawn the current is also cut off from the same.

LARGE UNITS

On units larger than No. 3 a different type of compressor is used which is illustrated on top of page 7. This compressor instead of having sliding blades as in the smaller sizes, delivers air by the displacement of two impellers.

These impellers mounted on two adjacent and parallel shafts displace the air by virtue of the lobe of one impeller entering into a pocket in the adjacent impeller. The impellers are separated a slight distance from each other and also from the casing of the compressor. There are, therefore, no direct rubbing surfaces at these points.

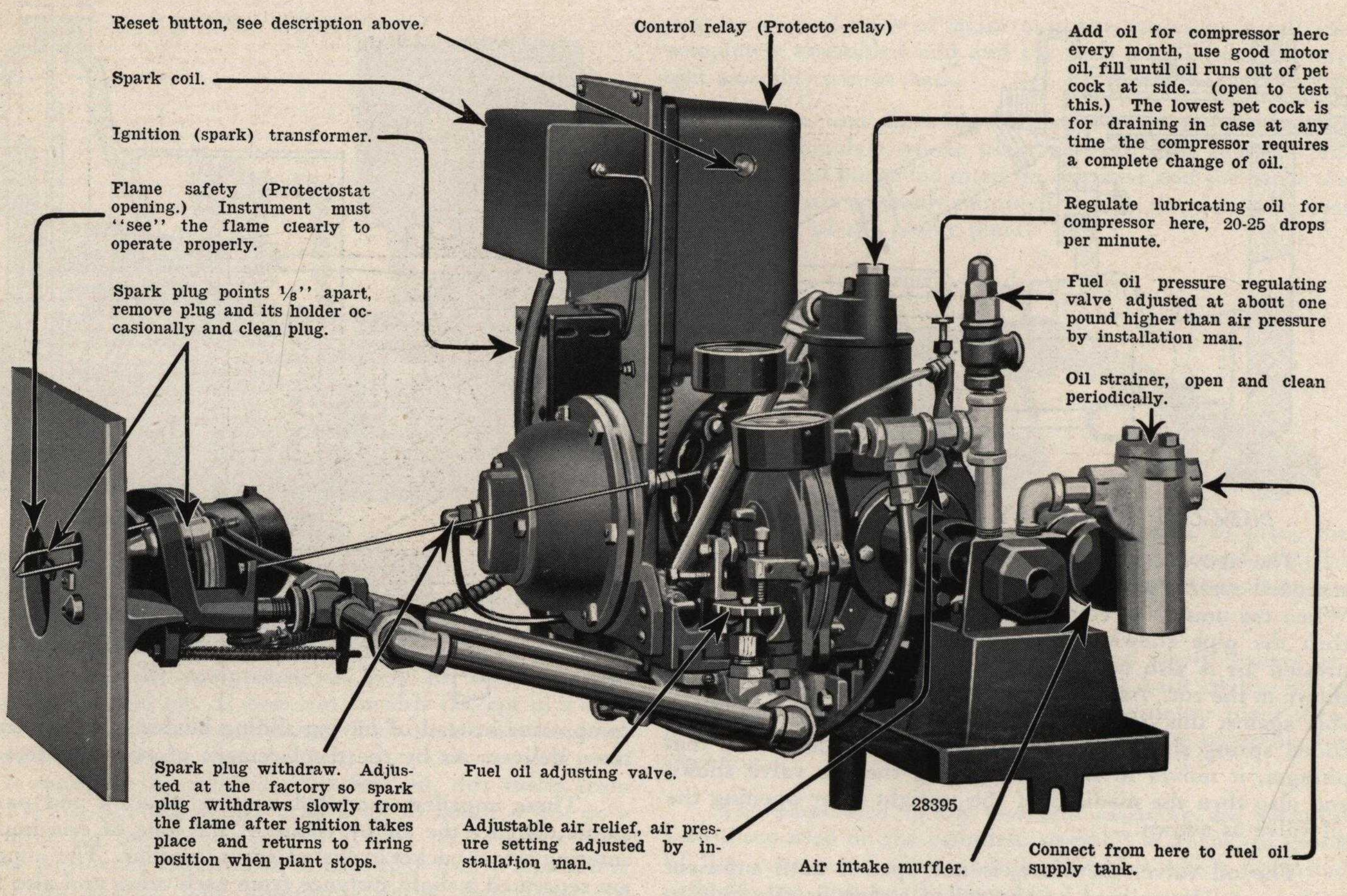
These impeller types of compressors are for ordinary service run dry and without lubrication except at the bearings, however, should it ever be necessary, their capacity can be increased to a considerable extent by feeding a slight amount of fuel oil into the compressor with the incoming air thereby sealing the spaces between the impeller blades themselves and the casing thereby reducing the air slip and increasing the amount of air delivered.

A sight feed oiler for feeding fuel oil into the incoming air for the above purpose is provided on all units larger than No. 3 but should not be used unless it is necessary to increase the capacity.

Increasing the capacity of the compressor by this means, of course, also increases the power necessary to drive same. As already stated, these compressors are of sufficient capacity when run dry to deliver their catalog rating and, therefore, it is seldom necessary to use the expedient of sealing the impellers by means of a slight amount of fuel oil as above described.

AUTOMATIC UNITS AND INDUSTRIAL UNITS

FULL AUTOMATIC UNITS can be furnished in sizes up to the rated capacity of 26,000 square feet steam radiation. INDUSTRIAL UNITS which are hand controlled as distinguished from full automatic controlled units can be furnished up to a size with a rated capacity of 67,000 sq. ft. of radiation. These are described farther on.



ELECTRIC IGNITION UNITS

The electric ignition unit shown above is identical in all respects with the gas ignition unit except as to the electric ignition.

In the electric ignition a spark plug, which is similar to the spark plugs used on automobiles, is supplied with current for ignition by means of a coil and transformer mounted on the unit.

The spark points of the spark plug (which points are separated about 1/8") project into the path of the fuel oil spray which is ignited by the spark and after ignition the spark plug is withdrawn or pulled back out of the flame to protect it from over-heating and from becoming fouled.

As stated, the spark plug is withdrawn after igniting the fuel oil but is returned automatically to the firing position whenever the unit shuts down only to be withdrawn again after performing its function of igniting the fuel on the next starting cycle.

Spark plugs should be inspected from time to time and kept clean if any soot or dirt accumulates on same.

At this point particular reference should be made to the fuel to be used with electric ignition units. With these it is of prime importance that the flash point be not over 170° F. open cup test. Further on fuel oil requirements are discussed in more detail.

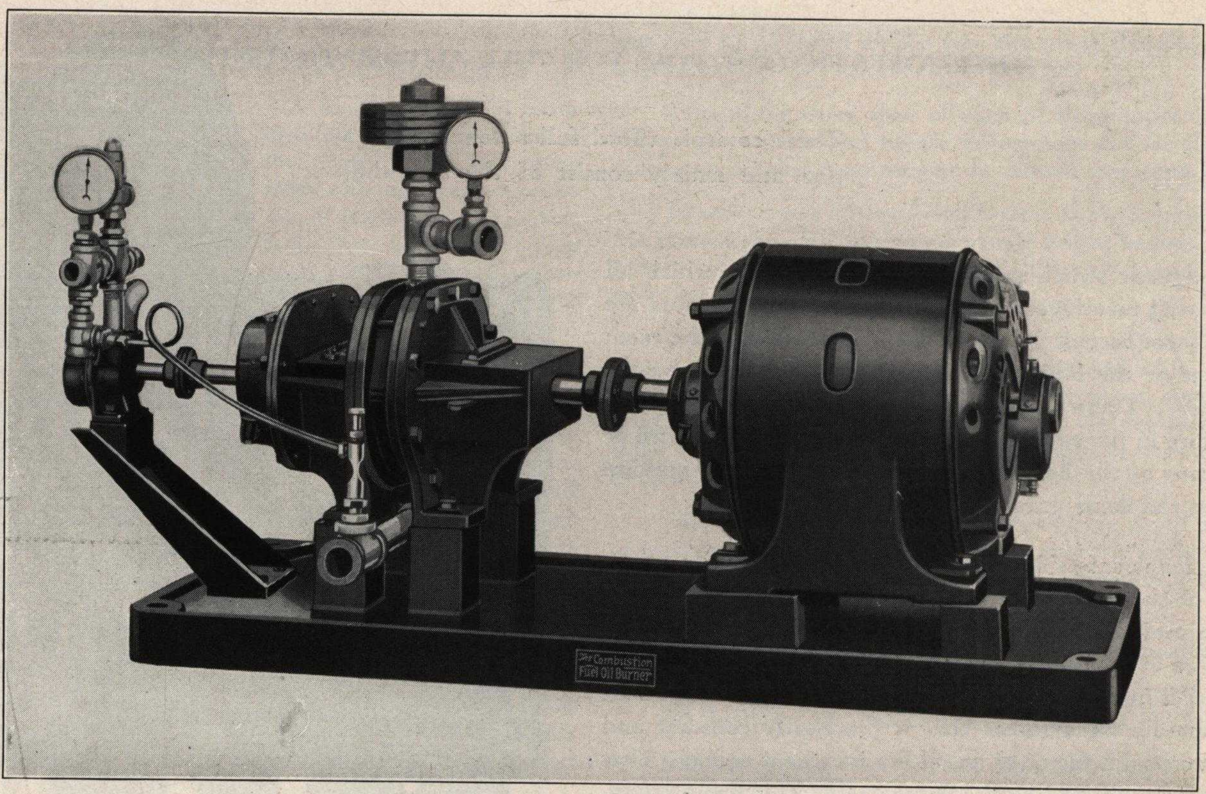
Electric ignition units are ordinarily called for in sizes from No. 0 to No. 3 or No. 4. We can furnish electric ignition units up to size No. 12, however, before ordering electric ignition units larger than No. 4 take the matter up with the home office, explaining what service will be required of these large units.

INDUSTRIAL UNITS

Industrial units can be furnished in sizes up to No. 16 having a rated capacity to take care of 67,000 sq. ft. of steam radiation. These units differ from the standard unit mainly in two particulars. The first is that they are manually operated instead of automatically operated and the second is that the nozzle is of the handwheel type for easy adjustment of the flame by hand as may be required by the condition of the service.

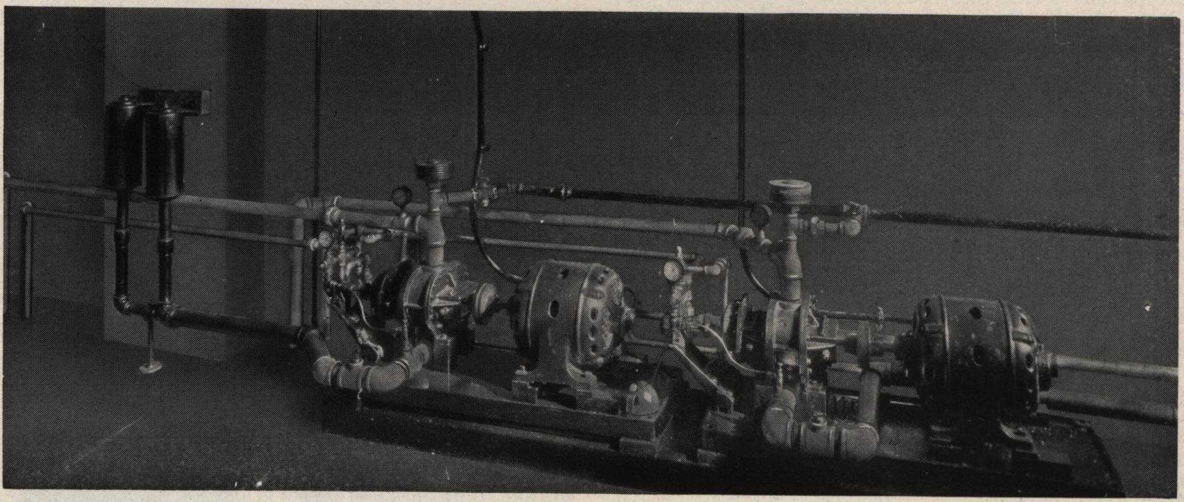
Industrial burners are commonly furnished for gas ignition only and the ignition is by means of a permanent gas jet so placed that it intersects the path of the oil spray for ignition.

As industrial units vary widely in their requirements, the burner power plants can be variously arranged or combined. This also applies to the nozzle and various auxiliaries.



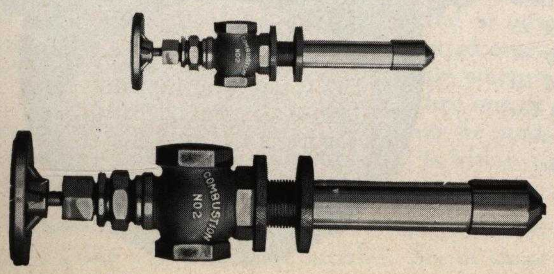
POWER PLANT—LARGE UNITS

Above cut shows the arrangement of parts for a medium size unit and the cut below shows an actual installation. The medium size units are direct connected, but the largest are belt driven.



An Industrial Installation

INDUSTRIAL TYPE NOZZLES

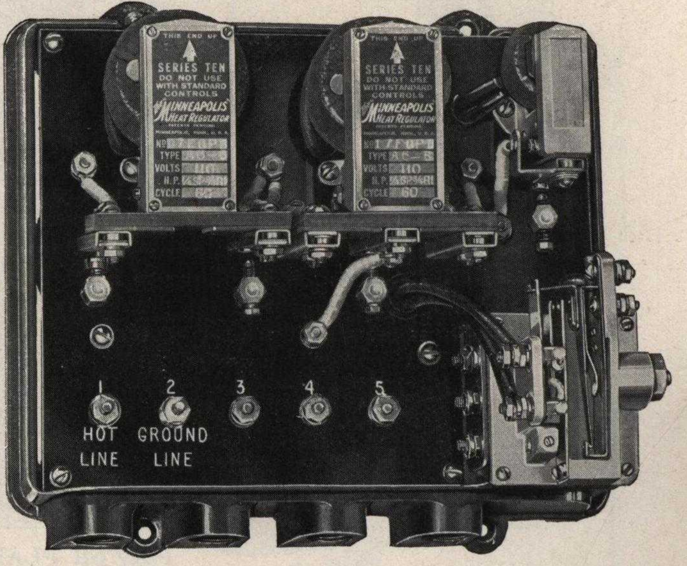


The industrial type of nozzle is here shown. It consists of a central tube thru which the oil flows and this is surrounded by a larger and adjustable tube thru which the air for atomization flows. This air impinges on the central oil stream from all sides at a sharp angle and atomizes the oil into a fine mist which it also spreads thereby enabling it to combine most intimately with the air for combustion. These nozzles are mounted so that the tip projects only about a half inch into the furnace and they are pointed and adjusted so as to give a flame of the size and shape that will best suit the combustion space.

THERMOSTATIC CONTROLS FOR FULL AUTOMATIC UNITS

These controls afford full automatic operation and mainly consist of the following:

A magnetic switch called a Protecto Relay to which all the following mentioned units of the control apparatus are electrically connected. Its operation is controlled by the room thermostat or the boiler limiting control as well as by the flame safety. These operate to shut down the burner if the temperature in the room becomes too high or the pressure or temperature of the boiler becomes unsafe or if the ignition fails when the flame goes out in the furnace.

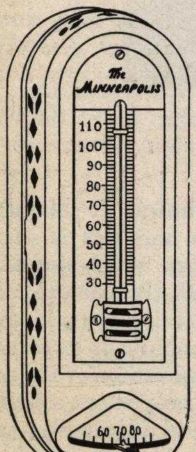


Protecto Relay

The flame safety illustrated on Page 9 is a most essential part of the control for full automatic operation. It is designed to prevent continuous operation of the burner in case of a failure in ignition at any time either at the start or after the burner is in operation. To operate a safety it is important that it operate on a factor that is practically constant and this most constant factor of an oil fire is radiant energy. That is, the energy radiated by the flame itself. This flame safety, therefore, operates due to the absence or presence of this radiant energy which is always present in the flame. If the flame is extinguished or if ignition at the start does not take place properly the flame safety will not allow the burner to run for more than a minute without shutting it down completely. This flame safety must be so located that it looks directly at the central and most constant part of the flame. On the standard unit this is provided for by means of a fixed casting but on special installations the flame safety with its separate adjusting collar is often shipped separately and must be rightly placed on the job.

The automatic controls are connected together electrically in such a manner that in order to start the burner, first, the room thermostat must be set for a temperature higher than that which exists in the room; second, the boiler must not be over-heated and third, the safety circuit must show everything safe.

As soon as the burner has started it may be automatically stopped; first, when the room is heated to the desired point by the thermostat; second, if before the room is sufficiently heated the boiler exceeds the safe temperature or pressure by the boiler limiting control and third, by the marked irregularity or extinguishment of the flame by the flame safety.

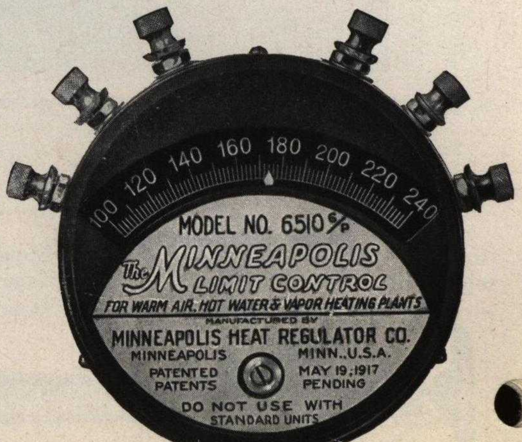


ROOM THERMOSTAT

A room thermostat responding to the temperature of the room it is desired to control, is illustrated at the left. It is usually set to maintain a temperature of about 70° F., but this setting can be changed manually to any point between 60° and 80° F.

HYDROSTATS and PRESSURESTATS

A boiler limiting device operating either by the temperature or the pressure to prevent the overheating of the boiler, is illustrated at the right. Instruments for various ranges of temperature or pressure are available.



FLAME SAFETY

A flame safety which recognizes the presence or absence of the flame in the combustion space allowing continued operation of the burner only as long as the flame is normal and shuts down the burner if the flame accidentally goes out or ignition fails. (See Page 8.)

INDUSTRIAL BOILERS

For general heating purposes burner units are most conveniently rated as to the amount of steam radiation they will take care of. This rating accordingly has been heretofore herein given. For large units, however, boilers are spoken of as being of a certain horse power and it is often desired to know what size burner is required to fire a boiler of a given horse power.

According to standard definition one boiler horse power calls for the evaporation of 34½ lbs. of water per hour from a temperature of 212° F. into steam at 212°. In other words one boiler horse power equals 34½ lbs. of water evaporated from and at 212°.

To evaporate one pound of water under these conditions requires 970.4 British Thermal Units, therefore, one boiler horse power will require the evaporation of 34½ times 970.4 B.T.U. or 33,479 B.T.U.

Since one gallon of average fuel oil contains 140,000 B.T.U.'s it would require, if the boiler was 100% efficient, to fire a 1 H.P. boiler 33,479/140,000 or nearly ¼ gallon; but since boilers are not 100% efficient it will require a larger quantity of oil, depending upon the size. Small boilers of 10 or 20 horse power rating are probably seldom more than 50% efficient, therefore, these small boilers will require twice the theoretical amount of oil.

As the boilers increase in size their efficiency increases up to as high as 70 or 75% thus requiring for boilers of this size an allowance of perhaps one-third more than the theoretical.

RATING NOZZLES AND BURNER UNITS

Burner units are rated according to the load they can carry. For example, a No. 3 unit is rated as capable of taking care of 2400′ of steam radiation allowing for one-third loss between furnace and radiators. Units are not adjustable and have this fixed approximate capacity for average service conditions. This cannot be varied materially because the motor and compressor are of a fixed size. Stated in other words a certain unit can atomize a certain amount of average fuel oil per hour, this, thereby, producing a certain amount of heat in the furnace. This oil may be atomized thru one or more nozzles, but whatever number of nozzles may be used they must be so adjusted that their total demand is within the capacity of the unit.

There are available three sizes of nozzles in each of three types making a total of nine nozzles. Six of these nine nozzles may be adjusted on the job, the other three are of fixed adjustment.

Thru these three sizes of each of three types of nozzles, the proper nozzle and nozzle adjustment can be had for almost any service requirement in almost any type of boiler.

In some cases a very long, narrow flame is necessary and the utmost capacity of a single nozzle might be called for. In other cases two or more nozzles might be needed to fill a wide but short combustion space.

It should be plain from the above that adjustable nozzles must of necessity have a variable rating and while for some installations where conditions are favorable a single nozzle might have a large maximum capacity, yet for other conditions the rating on that given nozzle might be very materially reduced.

The determining point is that units are rated according to their capacity, but nozzles are not generally spoken of fixed rating but are used in connection with a given unit to use the capacity of that unit according to conditions.

In addition to the above, three sizes of industrial nozzles are also available. (See Page 7.)

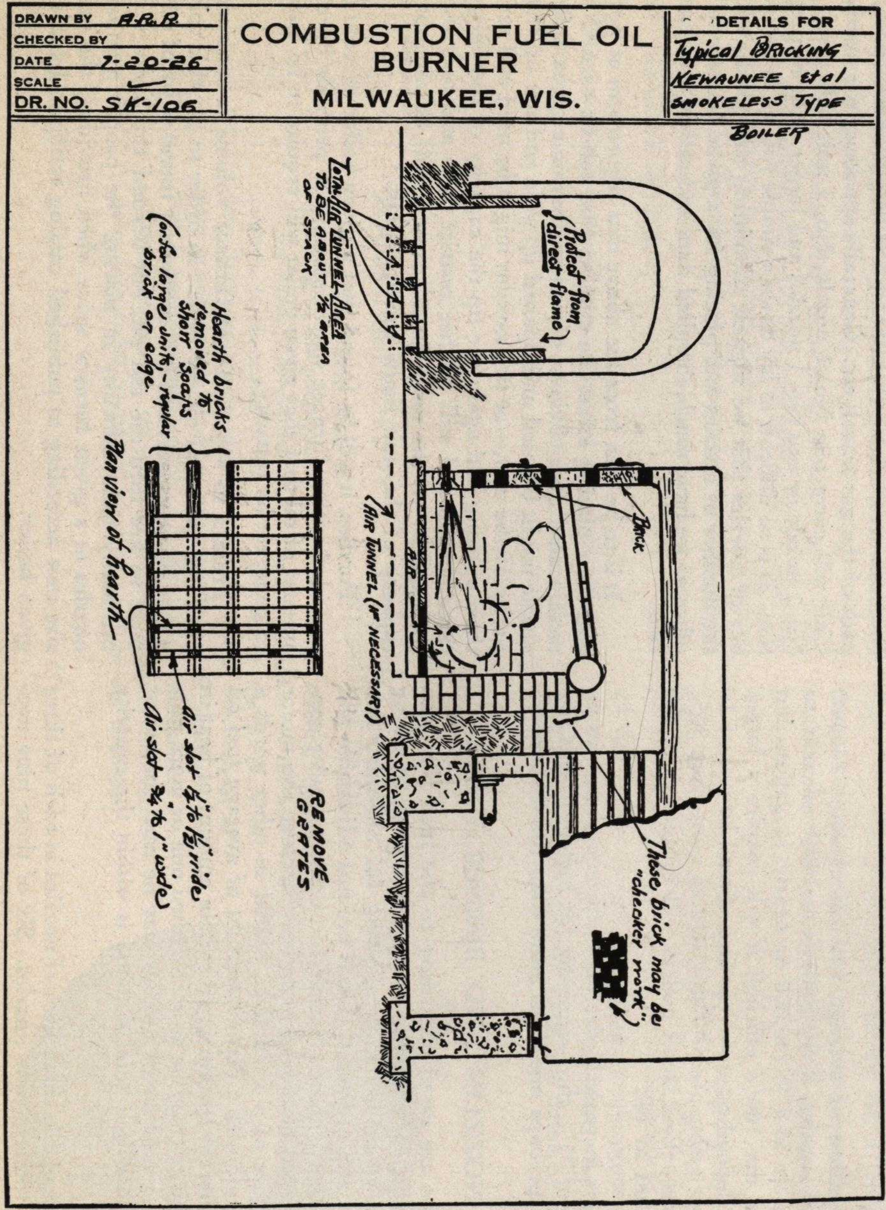
NUMBER OF NOZZLES FOR EACH UNIT

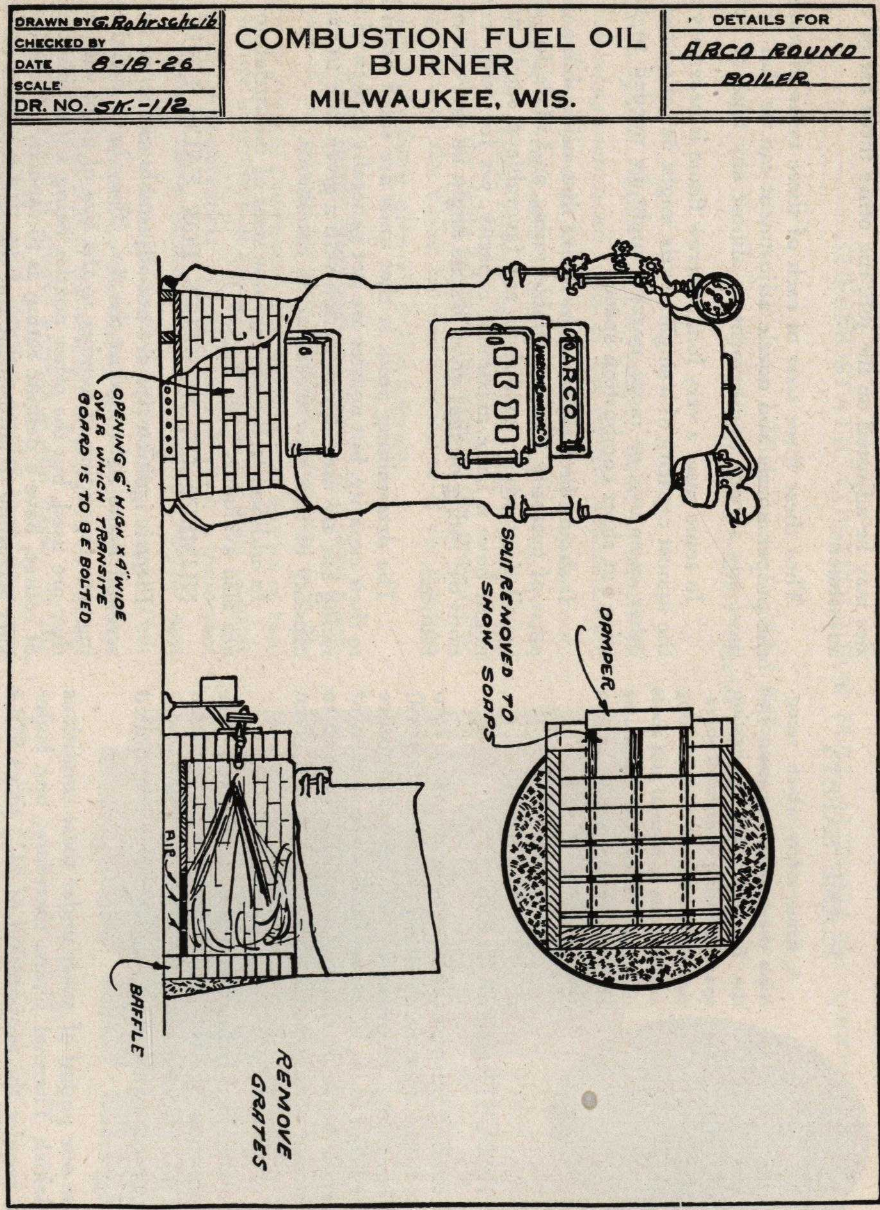
Electric ignition tips are not adjustable as the air tube is screwed home tight against the tip. They have definite ratings corresponding in number to the size of plant with which they are used, but the other nozzles being adjustable cannot, of course, have a definite rating as to capacity. Capacity will vary according to adjustment and this is determined by many circumstances, among them being the length of fire space, the path of the gas travel, etc. Generally speaking, the number 1 Unit will carry one No. 1 nozzle, No. 3 unit will carry one No. 2 nozzle or two No. 1 nozzles and larger units in proportion. It is so difficult to lay down a simple rule as to the number of nozzles that we suggest submitting the question as to the number of nozzles and placing for a given furnace to this office as we have much compiled data and rather wide experience.

It is to be seen from the above that adjustment of nozzles and their placing affect the number that can be carried by a certain unit. It is obvious, of course, that on a given unit one nozzle might be used and opened up wide and use up the capacity of the unit,—or two nozzles might be used and restrict their opening and again use up the capacity of the unit,—or three nozzles and still further restrict them and only use up the capacity of the unit. In all cases it will be obvious the capacity of the unit limits the operation.

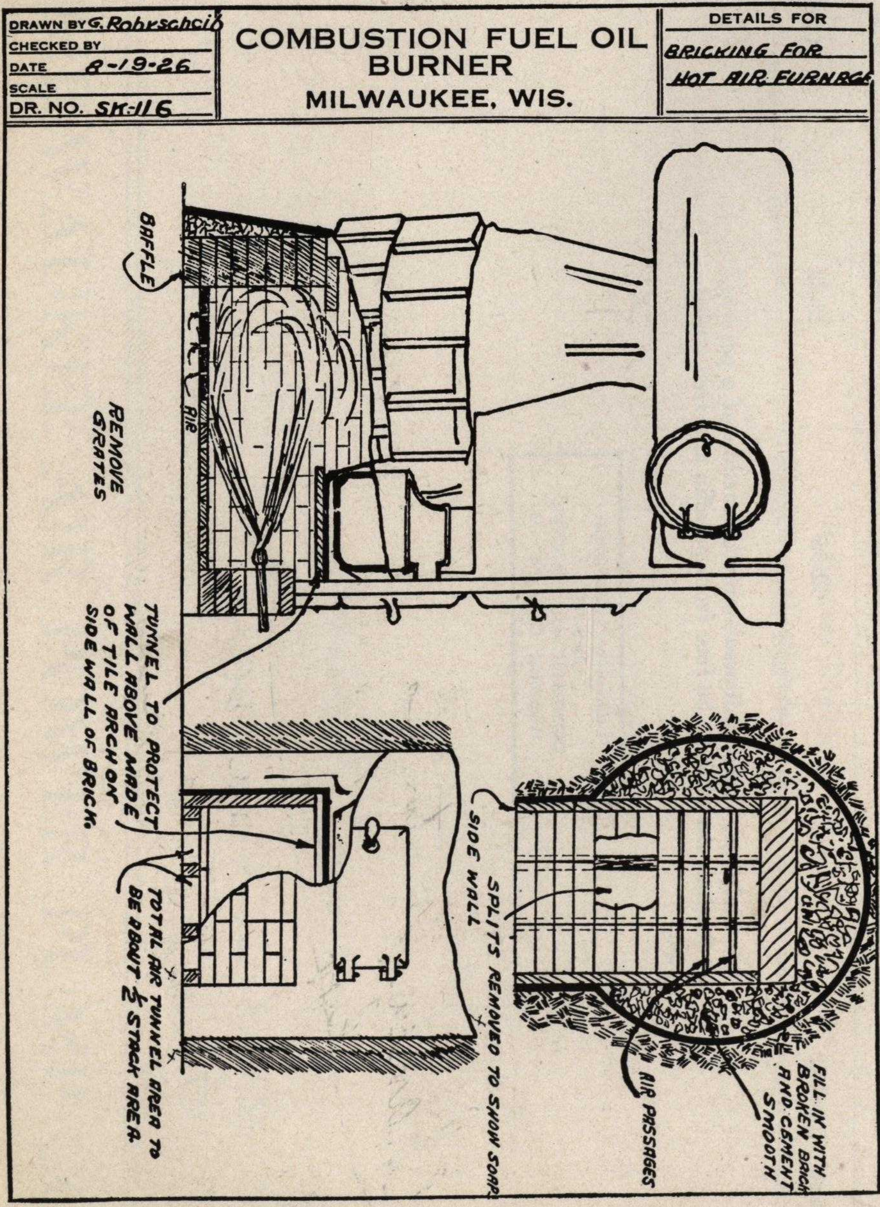
Further, it will be found that a given boiler is commonly provided with a furnace space sufficient to properly burn the amount of oil that that given boiler will require to be burned, to generate its capacity.

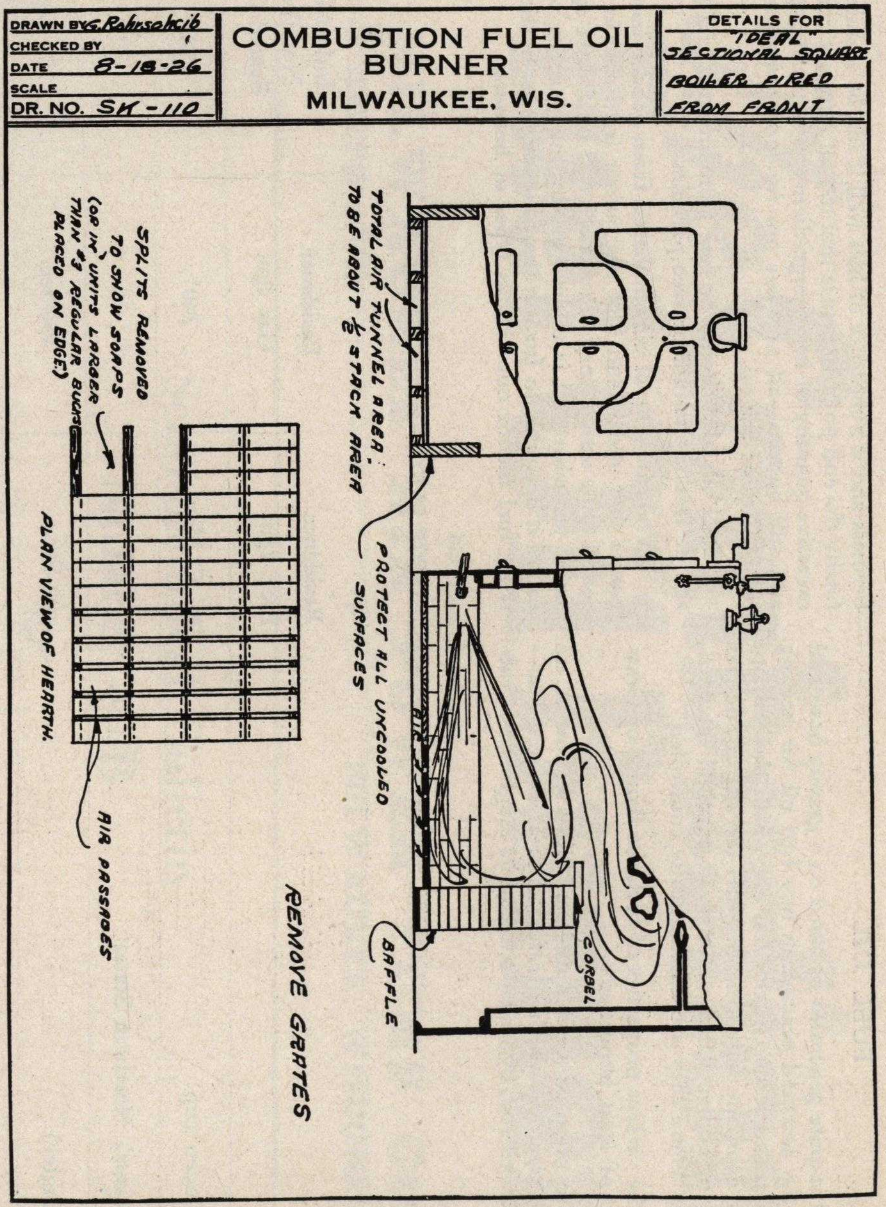
From 3 to 3½ cu. ft. of furnace volume is required to burn one gallon of oil per hour. In order to get this volume it may be necessary, and it is commonly found to be of advantage, to fire thru the ash pit, but beyond this there will be ordinarily little difficulty in placing the proper number of nozzles in a given furnace space when providing the proper size unit according to published catalog rating to handle the given boiler.





In bricking boilers it is important to see that the flame does not impinge upon water cooled surfaces. These should be protected by fire brick in order that the flame may not become chilled before combustion is completed. The drawings herewith are typical in a general way of how various standard styles of boilers are bricked and also showing how air is admitted for combustion. Notice the tip of the flame just impinges on the fire brick target wall in such a manner that it is turned back slightly upon itself. It is important that air port area be provided sufficient for the admission of air for combustion, (see page 11) considering that in practice it requires 1400 cu. ft. of air to burn one gallon of average fuel oil.





To admit sufficient air for proper combustion of the fuel oil, air openings thru hearth should be 7 sq. in. per gallon of oil per hour to be burned. For example a No. 3 unit (see page 3) has a rated capacity of about 5½ gallons of fuel oil per hour and this size unit will, therefore, require air openings thru the hearth having an area of 5½ times 7 or 38½ sq. in. or more. Stack area should be twice this amount.

FUEL OIL

Fuel oil is quite generally specified on a gravity basis and it has been the accepted practice to buy fuel oil for heating purposes on a Baume or Gravity test only, with the assumption that the company supplying the fuel oil will not deliver fuel oils having contents that will make it unsuited for burners especially where they are automatically controlled.

Of all the various properties of fuel, the Baume or Gravity is almost of least importance.

The flash point of a given oil—its ability to flow at, we will say, zero weather, which is referred to as its cold test—the viscosity of the oil, by which is meant its toughness or rubberiness and is a measure of how well it can be atomized, and finally the end point to insure that the oil does not contain an excessive quantity of heavy ingredients such as tar, asphaltum and still bottom—all of these are far more important than the gravity of the oil.

Fuel oils also should be free from any material percentage of free asphaltum or free paraffin.

While in general oil purchased from good reliable companies that understand how the burner is to operate will be found quite satisfactory when purchased on Baume specifications, yet where oil is to be used in any quantity we have found it desirable to furnish the following specifications covering fuel oil for our various types of burners:

COMBUSTION BURNER FUEL OIL SPECIFICATIONS

	Residence Elec. Ign.	Residence Gas Ign.	Industrial Not Pre-heated Oil
Flash Point open cup	170° F. Max.	240°	285°
Cold Test (pour) Northern States	-10 F.	-10	-10
Viscosity (Engler)	90 Sec.	150 Sec.	180 Sec.
End Point	600° F.	600	650
Gravity Baume' Approx.	32-36	28-32	24-26

Sulphur, water, sediment—only a fraction of a percent, —further, the oil is to be free from paraffin and free asphaltum.

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